

REMARKS/ARGUMENTS

Claims 1 and 27 have been amended to correct some minor typographical errors noted by the Applicant. Claims 1-50 are pending in the application.

Claim Rejections 103(a) – Tsujido and Stam

Claims 1-5 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Tsujido et al. (USPN 5,471,565) (hereinafter “Tsujido”) in view of Stam (USPN 6,246,416) (hereinafter “Stam”).

As amended, Claim 1 recites:

A computer rendering method comprising:
moving a semitransparent plane including a plurality of reflection points relative to an axis; and
rendering an image of the plurality of reflection points at a plurality of positions with respect to the axis such that each said point maps an elongated, continuous image.

Thus, the computer rendering method moves a semitransparent plane relative to an axis. This semitransparent plane includes multiple reflection points. The computer rendering method renders an image of these reflection points at positions with respect to the axis such that each of the reflection points on the semitransparent plane maps an elongate, continuous image. An example of such a computer rendering method is graphically illustrated in Fig. 8a-c of the Applicant’s Application. Neither Tsujido nor Stam discloses or suggests the computer rendering method recited in Claim 1.

Tsujido describes a method of displaying a rotary body as a realistic picture image by showing the projected and recessed surfaces of the body and shading

1 those surfaces in a realistic manner. (See Tsujido, col. 2, lines 19- 57). This
2 method described by Tsujido is significantly different from the computer
3 rendering method recited in Claim 1. For example, although Tsujido describes
4 surfaces of a rotary body, Tsujido does not disclose moving a semitransparent
5 plane relative to an axis. Also, the computer rendering method recited in Claim 1
6 renders an image of the reflecting points such that each point maps an elongated,
7 continuous image. In contrast, to display an image of the rotary body, the method
8 in Tsujido uses the projected and recessed surfaces of the body, not reflecting
9 points at positions with respect to an axis. Also, the surfaces in Tsujido are used
10 to display a rotary body, not to map an elongated, continuous image as recited in
11 Claim 1.

12 The Office Action asserts that Tsujido discloses rotating a rotary body
13 perpendicular to a rotational axis and that a particular point P in that rotary body
14 has a reflection factor R. The Office Action also asserts that Tsujido discloses
15 displaying a picture image with respect to the external line of a cross-section
16 which passes through the rotational axis. (See Office Action, page 2). The point P
17 referred to by the Office Action is a hypothetical point on the rotary body that is
18 used in Tsujido to discuss the reflection of light off the rotary body at a particular
19 point. (See Tsujido, Fig. 3). Assuming, for the sake of argument, that the Office
20 Action's assertions are correct, Tsujido merely discloses displaying a rotary body
21 with respect to a line in the body's cross-section where the body has some
22 reflective characteristics. However, Tsujido fails to disclose or suggest moving a
23 semitransparent plane or rendering an image of reflection points with respect to
24 the axis where each point maps an elongated, continuous image, as recited in
25 Claim 1.

1 The Office Action acknowledges that Tsujido does not teach rendering
2 image of reflection points. The Office Action argues that Stam teaches this
3 element. Stam describes a method for modeling reflection of light from an
4 anisotropic surface. This method of modeling involves calculating the distribution
5 of reflected light relative to the incoming light at a particular reflecting point on
6 the anisotropic surface. (See Stam, col. 3, lines 50-59). However, the reflecting
7 point described by Stam is not included in a semitransparent plane. Nor does the
8 reflecting point in Stam map an elongated, continuous image. Thus, the reflecting
9 point in Stam is not equivalent to the reflecting point as recited in Claim 1.

10 Even if Tsujido and Stam can be properly combined, the combination is
11 merely a method for realistically displaying surfaces of a rotary body where the
12 surfaces are anisotropic and can reflect light. However, nothing in Tsujido or
13 Stam discloses or suggests the computer rendering method as recited in Claim 1.

14 For at least the above-identified reason, Applicant respectfully submits that
15 Claim 1 is patentable over Tsujido and Stam, alone or in combination, and is
16 allowable. Since Claims 2-5 depend from Claim 1, Applicant respectfully submits
17 that Claims 2-5 are also allowable for at least the same reasons.

18
19 **Claim Rejections 103(a) – Tsujido, Stam, and Gröller**

20 Claims 6-7 stand rejected under 35 U.S.C. 103(a) as being unpatentable
21 over Tsujido in view of Stam, and in further view of Gröller et al. (“Modeling and
22 Visualization of Knitware”, IEEE 1995, pages 302-310) (hereinafter “Gröller”).

23 Claims 6 and 7 recite:

24 6. The computer rendering method as defined in Claim 1,
25 wherein:

1 a plurality of control points, each being located at an intersection of
2 two axes, define a three-dimensional (3D) surface of a macrostructure;
3 moving the semitransparent plane including the plurality of
4 reflection points relative to the axis further comprises rotating and
5 translating the plane of the reflection points respectively about and along
6 each said axis of the 3D surface of the macrostructure; and
7 rendering the image of the plurality of reflection points further
8 comprises rendering a 3D model from a plurality of images of a plurality of
9 positions of the planar plurality of reflection points with respect to each
10 said axis of the 3D surface of the macrostructure.

11 7. A computer-readable media comprising computer-executable
12 instructions for performing the computer rendering method as recited in
13 Claim 1.

14 As discussed above, neither Tsujido nor Stam discloses or suggests moving
15 a semitransparent plane that includes reflecting points, rendering an image of the
16 reflecting points at positions with respect to an axis, or a reflecting point that maps
17 an elongated, continuous image, as recited in independent Claim 1. Gröller fails to
18 cure these deficiencies.

19 Gröller describes a method for modeling and visualizing knitwear using
20 volumetric data. In particular, the frequency of fibers in a certain region of the
21 knitwear is reflected by a density value. (See Gröller, page 304). However,
22 Gröller does not disclose or suggest rendering an image of reflection points at
23 positions with respect to an axis such that each point maps an elongated,
24 continuous image, as recited in independent Claim 1. For at least these same
25 reasons, Applicant respectfully submits that dependent Claims 6 and 7 are
patentable over Tsujido, Stam and Gröller, alone or in combination, and are
allowable.

Furthermore, Gröller acknowledges that the method is not applicable for
mapping knitted fabrics onto free-form surfaces. (See Gröller, page 310). Thus,

1 since the modeling method described in Gröller cannot map fabric structures onto
2 free-form surfaces, Gröller also fails to disclose rotating and translating the plane
3 of the reflection points respectively about and along each axis of a 3D surface of
4 the macrostructure, and rendering a 3D model from images of positions of the
5 planar reflection points with respect to each axis of a 3D surface of a
6 macrostructure, as recited in dependent Claim 6.

7 Thus, even if Gröller can be combined with Tsujido and Stam, the resulting
8 combination is merely a method for realistically displaying two dimensional
9 surfaces of a body where the surfaces can reflect light and are associated with
10 some volumetric data for modeling and visualization. However, this combination
11 does not disclose or suggest the computer rendering method recited in Claim 6.
12 Applicant respectfully submits that Claim 6 is patentable over Tsujido, Stam and
13 Gröller, alone or in combination, and is allowable for at least these additional
14 reasons.

15
16 **Claim Rejections 103(a) –Gröller and Westin**

17 Claims 8-32 and 36-46 stand rejected under 35 U.S.C. 103(a) as being
18 unpatentable over Gröller in view of Westin et al. (“Predicting Reflectance
19 Functions from Complex Surfaces”, ACM published 1992) (hereinafter “Westin”).

20 Claim 8 recites:

21 A modeling method comprising:
22 generating a macrostructure for a three-dimensional (3D) object
23 defined by a plurality of axes; and
24 applying a semitransparent microstructure, defined by planar
25 plurality of reflection points, to the macrostructure by moving the plane of
the reflection points with respect to each said axis to yield a 3D model.

1
2 Thus, the modeling method in Claim 8 applies a semitransparent
3 microstructure defined by planar reflection points to a macrostructure for a three-
4 dimensional object defined by axes. The microstructure is applied to the
5 macrostructure by moving the plane of the reflection points with respect to each
6 axis to yield a 3D model. Gröller and Westin fail to disclose or suggest this
7 method of generating a 3D model.

8 As discussed above, Gröller describes a method for modeling and
9 visualizing knitwear using volumetric data. This method disclosed by Gröller
10 cannot map fabric structures onto free-form surfaces. To render a model with
11 fabrics, the Gröller method has to tile quadrilaterals that simulate the fabrics onto
12 an image plane of the model. (See Gröller, page 305 to 306; and Fig. 9a-b and
13 11a-b). Unlike the method described in Gröller that approximates the model by
14 tiling, the method recited in Claim 8 yields the 3D model by moving the plane of
15 reflection points with respect to each axis of the 3D object. Thus, the method
16 described in Gröller is significantly different from the modeling method recited in
17 Claim 8.

18 The Office Action acknowledges that Gröller does not teach transparent
19 model. But the Office Action argues that Westin teaches the modeling of
20 “microgeometries that include transparent materials”. (See Office Action, page 4).
21 Westin describes a method for predicting reflectance functions from complex
22 surfaces. However, nothing in Westin discloses or suggests a semitransparent
23 microstructure that is defined by planar reflection points and that is applied to a
24 macrostructure by moving the plane of the reflection points with respect to each
25 axis of a 3D object, as recited in Claim 8.

Even if Gröller and Westin can be combined, the combination would only
yield a method for modeling microgeometries with transparent materials that tiles

1 the surfaces of the geometries with quadrilaterals and simulates the reflectance of
2 the surfaces. However, the combination fails to disclose or suggest the modeling
3 method recited in Claim 8.

4 For the above-identified reasons, Claim 8 is patentable over Gröller and
5 Westin, alone or in combination, and is allowable. Given that Claims 9-12 depend
6 from Claim 8, Claims 9-12 are also allowable for at least the same reasons.

7 Claim 13 recites:

8 A method for rendering knitwear, the method comprising:
9 generating a macrostructure for a three-dimensional (3D) object
10 defined by a plurality of intersecting axes;
11 applying a stitch pattern to each said axis; and
12 applying a semitransparent lumislice to each said stitch pattern to
13 yield a 3D knitwear model.

14 As discussed above, Westin merely describes a method for predicting
15 reflectance on a surface. Gröller describes a method for modeling and visualizing
16 knitwear using volumetric data. But the method disclosed by Gröller cannot map
17 fabric structures onto free-form surfaces. Gröller also describes an analytical
18 model for modeling a yarn that includes a skeleton curve and the cross-sections of
19 different yarn types. (See Gröller, page 304; and Fig. 5, 6 and 7a-c). However,
20 this analytical model is merely used to calculate the volumetric data for indirectly
21 rendering an object with fabrics, not to create a 3D knitwear model using a
22 lumislice.

23 To render a model with fabrics, the Gröller method has to tile quadrilaterals
24 that simulate the fabrics onto an image plane of the model. Unlike the tiling
25 method in Gröller, the method recited in Claim 13 generates the 3D knitwear
model by applying a semitransparent lumislice to each stitch pattern, which is
applied to each axis that defines the 3D object. Thus, Gröller and Westin, alone or

1 in combination, do not disclose or suggest the method recited in Claim 13.

2 For the above-identified reasons, Claim 13 is patentable over Gröller and
3 Westin, alone or in combination, and is allowable. Given that Claims 14-17
4 depend from Claim 13, Claims 14-17 are also allowable for at least the same
5 reasons.

6 Claim 18 recites:

7 A method for rendering knitwear, the method comprising:
8 generating a macrostructure, the macrostructure being defined by the
9 plurality of axes connecting a plurality of control points, each said control
10 point being situated at an intersection of at least two of the axes, the
11 plurality of axes defining a three-dimensional (3D) object;
12 applying a stitch pattern to each said axis; and
13 applying a yarn microstructure, defined by a planar plurality of
14 reflection points, to each stitch of the stitch pattern applied to each axis
15 defining the 3D object by rotating and translating the plane of the reflection
16 points perpendicular with respect to each said axis to yield a 3D knitwear
17 model.

18 As discussed above, although Gröller describes an analytical model for
19 modeling a yarn that includes a skeleton curve and the cross-sections of different
20 yarn types, the method disclosed by Gröller cannot map fabric structures onto
21 free-form surfaces. Thus, Gröller fails to disclose or suggest generating a 3D
22 knitwear model by applying a yarn microstructure to each stitch of a stitch pattern
23 applied to each axis of a 3D object by rotating and translating the plane of the
24 reflection points perpendicular with respect to each axis, as recited in Claim 18.

25 For the above-identified reasons, Claim 18 is patentable over Gröller and
Westin, alone or in combination, and is allowable. Given that Claims 19-26
depend from Claim 18, Claims 19-26 are also allowable for at least the same
reasons.

Claim 27 recites:

1 A computer rendering method comprising:
2 moving a plurality of voxels contained within parallel opposing
3 planes with respect to an axis that is perpendicular to the parallel opposing
4 planes, each said voxel being semitransparent and having a reflectance
5 factor and a plurality of reflection points having a density; and
6 rendering an image of the plurality of voxels at a plurality of
7 positions with respect to the axis such that at least one said point maps an
8 elongated, continuous image.

9 As discussed above, Gröller describes a method for modeling and
10 visualizing knitwear using volumetric data where the frequency of fibers in a
11 certain region of the knitwear is reflected by a density value. Although Gröller
12 describes the use of a density value, Gröller fails to disclose the use of voxels. As
13 recited in Claim 27, voxels are contained within parallel opposing planes. The
14 voxels are semitransparent and have a reflectance factor and reflection points
15 having a density. Nothing in Gröller discloses anything that is equivalent to a
16 voxel. Thus, Gröller also fails to disclose moving such voxels with respect to an
17 axis that is perpendicular to the parallel opposing planes and rendering an image
18 of the voxels with respect to the axis such that at least one point maps an
19 elongated, continuous image, as recited in Claim 27.

20 For at least the above-identified reasons, Claim 27 is patentable over
21 Gröller and Westin, alone or in combination, and is allowable. Given that Claims
22 28-32 depend from Claim 27, Claims 28-32 are also allowable for at least the
23 same reasons.

24 Claim 37 recites:

25 A method for rendering knitwear, the method comprising:
 generating a macrostructure for a three-dimensional (3D) object
 defined by a plurality of intersecting axes;
 applying a stitch pattern to each said axis;
 applying a yarn microstructure, defined by a plurality of voxels

1 contained within parallel opposing planes, to the macrostructure by
2 translating and rotating the plurality of voxels contained within parallel
3 opposing planes perpendicular respectively along and about each stitch of
4 the stitch pattern applied to each said axis, wherein each said voxel is
5 semitransparent and has a reflectance factor and a plurality of points having
6 a density; and

7 rendering a 3D knitwear model from a combination of images of the
8 plurality of voxels at a plurality of positions with respect to the plurality of
9 axes.

10 As discussed above, Gröller does not disclose the use of voxels. Thus,
11 Gröller also fails to disclose a yarn microstructure defined by voxels or applying
12 such yarn microstructure to a macrostructure by translating and rotating the voxels
13 contained within parallel opposing planes perpendicular respectively along and
14 about each stitch of the stitch pattern applied to each axis, as recited in Claim 37.

15 For at least the above-identified reasons, Claim 37 is patentable over
16 Gröller and Westin, alone or in combination, and is allowable. Given that Claims
17 38-44 depend from Claim 37, Claims 38-44 are also allowable for at least the
18 same reasons.

19 Claim 45 recites:

20 A machine-readable medium having instructions stored thereon for
21 execution by a processor to perform a method for rendering knitwear, the
22 method comprising:

23 generating a parameterized surface describing a three-dimensional
24 (3D) knitwear macrostructure;

25 determining a plurality of control points that define the
parameterized surface, wherein each said control point is located at an
intersection of two axes;

applying a stitch pattern to each of the control points of the knitwear
skeleton to form a skeleton of the yarn stitches;

discretizing the skeleton of the yarn stitches into a plurality of
discretized yarn segments;

sorting the discretized yarn segments according to a viewing
condition of a scene including the knitwear macrostructure and a distance
of a view of the scene;

inputting the plurality of discretized yarn segments into:
a geometry of the scene; and
a lighting condition of the scene;
applying a lumislice, with respect to a resolution of the distance of
the view of the scene and a sampling density, to each stitch of the stitch
pattern of the sorted discretized yarn segments by translating and rotating
the lumislice perpendicular to and respectively along and about each stitch
of the stitch pattern applied to the plurality of intersecting axes, wherein the
lumislice is semitransparent and is computed from a fiber distribution of a
yarn cross-section; and
rendering a synthesis of the scene including the knitwear
macrostructure using the sorted discretized yarn segments having the
lumislice applied thereto, the viewing condition of the scene, and the
distance of the view of the scene.

In rejecting Claim 45, the Office Action simply asserts that the claimed
features are disclosed in 8 pages of the Gröller reference. (See Office Action,
page 7). However, materials in these 8 pages do not disclose or suggest the
elements in Claim 45, such as the elements that are related to a scene. In fact,
Gröller does not disclose or suggest any material that is related to a scene.
Applicant respectfully submits that this rejection is not properly supported and
should be withdrawn.

As discussed above, although Gröller describes an analytical model for
modeling a yarn that includes a skeleton curve and the cross-sections of different
yarn types, the method disclosed by Gröller cannot map fabric structures onto
free-form surfaces. Thus, Gröller fails to disclose applying a stitch pattern to each
of the control points of the knitwear skeleton to form a skeleton of the yarn
stitches where the control points define a parameterized surface. Gröller also fails
to disclose the elements in Claim 45 that are related to a scene. For at least the
above-identified reasons, Claim 45 is patentable over Gröller and Westin, alone or
in combination, and is allowable. Given that Claim 46 depends from Claim 45,
Claim 46 is also allowable for at least the same reasons.

1
2 **Claim Rejections 103(a) –Gröller, Westin and Neyret**

3 Claims 33, 47, and 48 stand rejected under 35 U.S.C. 103(a) as being
4 unpatentable over Gröller in view of Westin, and in further view of Neyret
5 (“Modeling, Animating, and Rendering Complex Scene Using Volumetric
6 Texture”, IEEE 1998, pages 55-70) (hereinafter “Neyret”).

7 Claim 33 recites:

8 33. The method as defined in Claim 27, wherein each of the
9 voxels has an associated opacity and voxel reflectance function (VRF).

10 As discussed above, Gröller fails to disclose moving voxels with respect to
11 an axis that is perpendicular to the parallel opposing planes and rendering an
12 image of the voxels with respect to the axis such that at least one point maps an
13 elongated, continuous image, as recited in independent Claim 27. Although
14 Neyret mentions a reflectance function related to a voxel, the method described in
15 Neyret fails to disclose how such voxel and the associated reflection function are
16 used to render an image, as recited in Claims 27 and 33.

17 Even if Neyret can be combined with Gröller and Westin, the combination
18 merely includes a method for modeling an object that tiles the surfaces of the
19 object with quadrilaterals and simulates the reflectance of the surfaces with a
20 reflectance function. However, the combination does not disclose or suggest the
21 computer rendering method recited in Claim 33. For at least the above-identified
22 reasons, Claim 33 is patentable over Gröller, Westin and Neyret, alone or in
23 combination, and is allowable.

24 Claims 47 and 48 recite:

25 47. The medium of Claim 45, further comprising, before applying
the lumislice, computing a shadow map from the geometry of the scene and

1 the lighting condition, wherein the synthesis of the scene is rendered using
2 the computed shadow map.

3 48. The medium of Claim 45, wherein:
4 each said lumislice characterizes attributions of a cross-sectional
5 slice of yarn of the yarn stitches that is divided into voxels; and
6 each of the voxels has an associated opacity and voxel reflectance
7 function (VRF).

8 As discussed above, although Neyret mentions a reflectance function
9 related to a voxel, the combination of Gröller, Westin and Neyret fails to disclose
10 how such voxel and the associated reflection function are used to render an image.
11 Thus, the combination also fails to disclose how the voxels and reflection function
12 are used to render a scene as recite in Claims 47 and 48. For at least the above-
13 identified reasons, Claims 47-48 are patentable over Gröller, Westin and Neyret,
14 alone or in combination, and are allowable.

15 **Claim Rejections 103(a) –Gröller, Westin, Neyret and Hanrahan**

16 Claims 34, 35, 49 and 50 stand rejected under 35 U.S.C. 103(a) as being
17 unpatentable over Gröller in view of Westin, and in further view of Neyret and
18 Hanrahan et al. (“Reflection from Layered Surfaces due to Subsurface Scattering”,
19 ACM 1993, pages 165-174) (hereinafter “Hanrahan”).

20 Claims 34, 35, 49 and 50 recite:

21 34. The method as defined in Claim 33, wherein:
22 the VRF represents the brightness of a voxel viewed from direction
23 $V(\theta_v, \phi_v)$ when illuminated by a unit intensity light from direction $L(\theta_l, \phi_l)$;
24 the VRF is represented by a four-dimensional color array after
25 discretization of the four angles $\theta_l, \phi_l, \theta_v, \phi_v$;
 θ is a longitude angle; and
 ϕ is an altitude angle.

35. The method as defined in Claim 34, wherein:

1 the discretization of the four angles $\theta_l, \phi_l, \theta_v, \phi_v$ comprises the
2 discretization into directional increments;
3 the directional increments for the longitude angle are $\theta \in [0, 2\pi]$; and
4 the directional increments of the altitude angle are $\phi \in [-\pi/2, \pi/2]$.

5 49. The medium as defined in Claim 48, wherein:
6 the VRF represents the brightness of a voxel viewed from direction
7 $V(\theta_v, \phi_v)$ when illuminated by a unit intensity light from direction $L(\theta_l, \phi_l)$;
8 the VRF is represented by a four-dimensional color array after
9 discretization of the four angles $\theta_l, \phi_l, \theta_v, \phi_v$;
10 θ is a longitude angle; and
11 ϕ is an altitude angle.

12 50. The medium as defined in Claim 49, wherein:
13 the discretization of the four angles $\theta_l, \phi_l, \theta_v, \phi_v$ comprises the
14 discretization into directional increments;
15 the directional increments for the longitude angle are $\theta \in [0, 2\pi]$; and
16 the directional increments of the altitude angle are $\phi \in [-\pi/2, \pi/2]$.

17 As discussed above, Gröller, Westin and Neyret, alone or in combination,
18 fail to disclose or suggest the method recited in independent Claims 33 and 45.
19 Hanrahan fails to cure the deficiencies of these three references.

20 Hanrahan describes a model for representing reflection from layered
21 surfaces due to subsurface scattering. The model described in Hanrahan "is
22 particularly appropriate for common layered materials appearing in nature, such as
23 biological tissues (e.g. skin, leaves, etc.) or inorganic materials (e.g. snow, sand,
24 paint, varnished or dusty surfaces)." (See Hanrahan, Abstract). Although the
25 model in Hanrahan includes some angles variables, this model is not equivalent to
the methods recited in Claims 34-35 and 49-50, which are applicable to voxels.
Particularly, the claims recite that the VRF is represented by a four-dimensional
color array after discretization of the four angles $\theta_l, \phi_l, \theta_v, \phi_v$. Hanrahan does not
disclose or suggest such a four-dimensional color array.

For at least the above-identified reasons, Claims 34-35 and 49-50 are

1 patentable over Gröller, Westin, Neyret and Hanrahan, alone or in combination,
2 and are allowable.

3
4 **Conclusion**

5 Claims 1-50 are in condition for allowance. Applicant respectfully requests
6 the issuance of the subject application. Should any matter in this case remain
7 unresolved, the undersigned attorney respectfully requests a telephone conference
8 with the Examiner to resolve any such outstanding matter.

9
10 Respectfully Submitted,

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13 Date: 8/4/2004

14 By: 

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